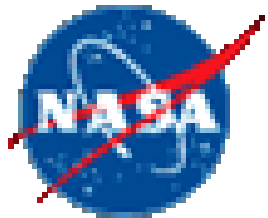




NACP Data Management Planning Workshop

*Diane E. Wickland, Co-Chair
Carbon Cycle Interagency
Working Group*

January 25, 2005



NIST



USDA



U.S. Climate Change Science Program: Carbon Cycle Science Program

An Interagency Partnership

USGS
science for a changing world



<http://www.carboncyclescience.gov>

U.S. Carbon Cycle Science Program



GLOBAL CARBON CYCLE: OVERARCHING QUESTIONS

Societal Question: What are our options for managing carbon sources and sinks to achieve an appropriate balance of risk, cost and benefits to society?

Scientific Question: How large and variable are the dynamic reservoirs and fluxes of carbon within the Earth system, and how might carbon cycling change and be managed in future years, decades, and centuries?



Why Carbon Cycle Science?

Information on carbon cycling is needed:

- to reduce uncertainties concerning the potential for climate change
 - projections of future atmospheric CO₂ and CH₄ concentrations
 - improved process controls for climate models
- to evaluate carbon management options being considered by society
 - effects of changes in emissions of CO₂ and CH₄
 - effects of deliberate carbon sequestration through enhancement of biospheric storage processes or engineering approaches
- for effective natural resource management in a changing world



Carbon Cycle Science Questions

1. What are the magnitudes and distributions of **North American carbon sources and sinks** on seasonal to centennial time scales, and what are the processes controlling their dynamics?
2. What are the magnitudes and distributions of **ocean carbon sources and sinks** on seasonal to centennial time scales, and what are the processes controlling their dynamics?
3. What are the effects on carbon sources and sinks of past, present, and future **land use change and resource management practices** at local, regional, and global scales?
4. How do **global** terrestrial, oceanic, and atmospheric **carbon sources and sinks** change on seasonal to centennial time scales, and how can this knowledge be integrated to quantify and explain **annual global carbon budgets**?
5. What will be the **future atmospheric concentrations of carbon dioxide, methane, and other carbon-containing greenhouse gases**, and how will terrestrial and marine carbon sources and sinks change in the future?
6. How will the Earth system, and its different components, respond to various options for **managing carbon in the environment**, and what scientific information is needed for evaluating these options?



U.S. Carbon Cycle Near-Term Priorities

Implementing:

- **North American Carbon Program (NACP)**
- **Ocean Carbon and Climate Change (OCCC)**

These two programs were planned through the auspices of the Carbon Cycle Science Steering Group and address, primarily, the first two of the six Global Carbon Cycle questions (but will have significant research activity that also will address other questions).

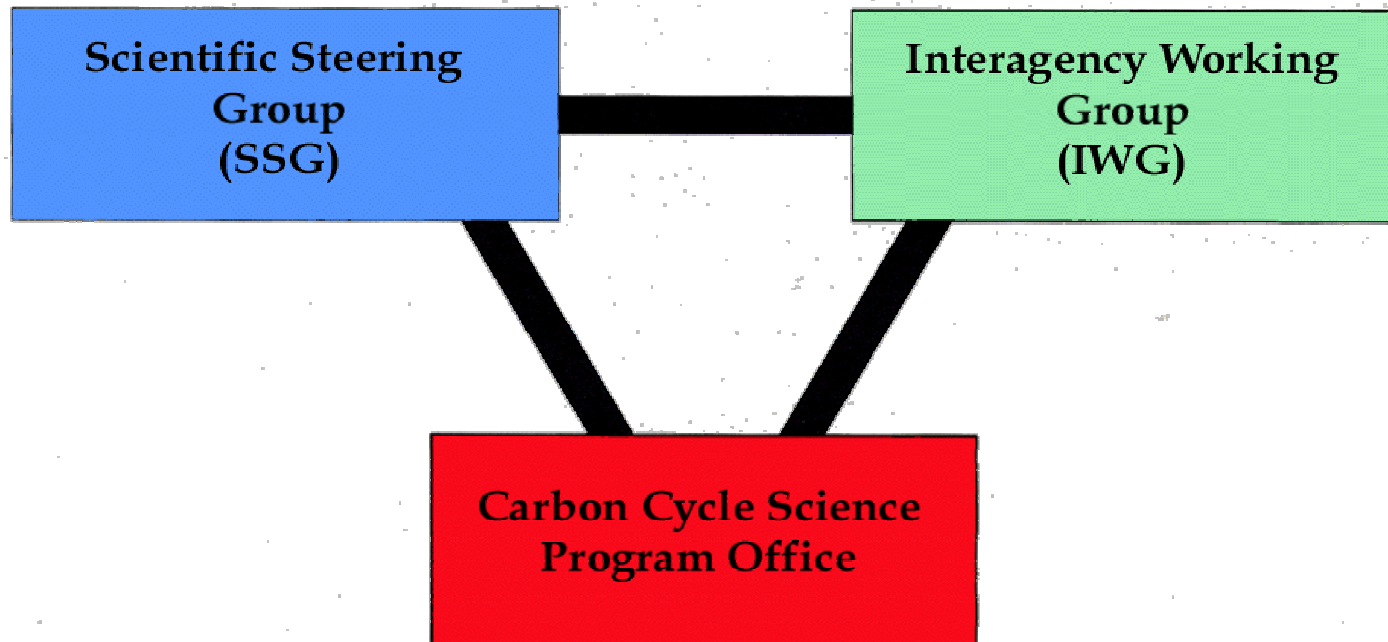
Producing:

- **First State of the Carbon Cycle Report (SOCCR)**

SOCCR is not now integrated into the NACP, but rather is a separate activity that will draw primarily from past research; future SOCCRs will draw more and more from NACP results and a closer relationship may become desirable.



APPROACH AND IMPLEMENTATION



Carbon Cycle Interagency Working Group (CCIWG) Co-Chairs: Dr. Diane Wickland, NASA and Dr. Roger Dahlman, DOE

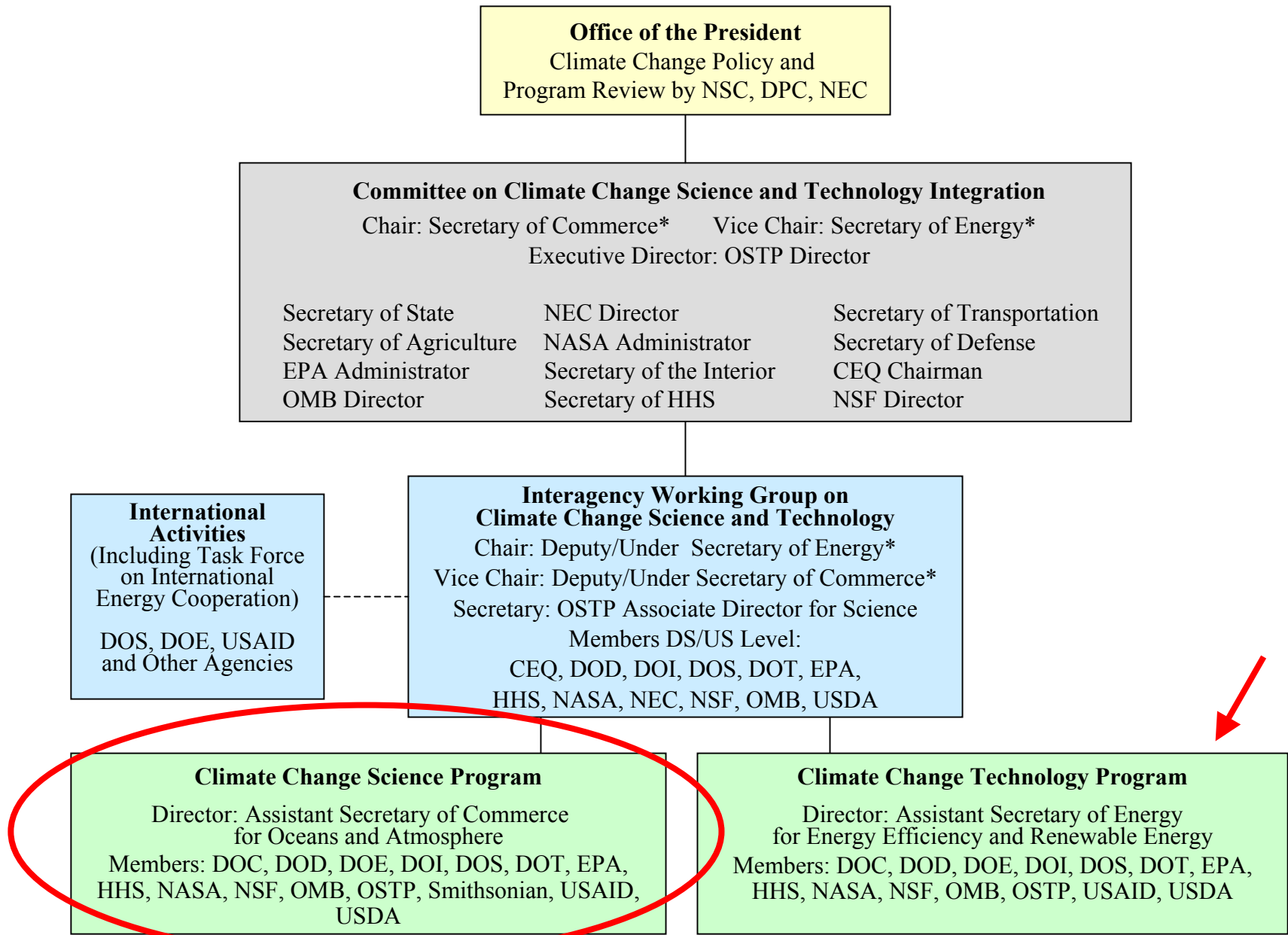
Carbon Cycle Science Steering Group (CCSSG) Chair: Dr. Chris Field, Carnegie Institute

Carbon Cycle Program Office Director: Dr. Roger Hanson

Carbon Cycle Program Officer: Ms. Gloria Rapalee

**U.S. Climate Change Science
and Technology Integration
&
Climate Change Science
Program**

Committee on Climate Change Science & Technology Integration



*Chair and Vice Chair of Committee and Working Group rotate annually

U.S. Climate Change Science Program (CCSP)

Core Approaches:

- Scientific Research
- Observations
- Decision Support
- Communications

Scientific Research Elements:

- Atmospheric Composition
- Climate Variability and Change
- Global Water Cycle
- Land-Use / Land-Cover Change
- **Global Carbon Cycle**
- Ecosystems
- Human Contributions and Responses

U.S. Climate Change Science Program (CCSP)

CCSP incorporates:

- **U.S. Global Change Research Program** (USGCRP; established 1990)
- **Climate Change Research Initiative** (CCRI; created 2001)

CCSP Goals:

1. Improve knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed variability and change.
2. **Improve quantification of the forces bringing about changes in the Earth's climate and related systems. (Global Carbon Cycle mainly here)**
3. Reduce uncertainty in projections of how the Earth's climate and related systems may change in the future
4. Understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes.
5. Explore the uses and identify the limits of evolving knowledge to manage risks and opportunities related to climate variability and change.

U.S. Climate Change Science Program (CCSP)

Synthesis and Assessment Products:

CCSP will produce a variety of synthesis and assessment products to support both policymaking and adaptive management.

Under Goal 2, the following Synthesis and Assessment product, relevant to carbon cycle science, is to be produced by the end of 2005:

SAR 2.2 - North American carbon budget and implications for the global carbon cycle

The CCIWG believes the first *State of the Carbon Cycle Report* (SOCCR) can serve as SAR 2.2 and has provided a *Prospectus* to the CCSP proposing this, but the *Prospectus* has not been approved yet.



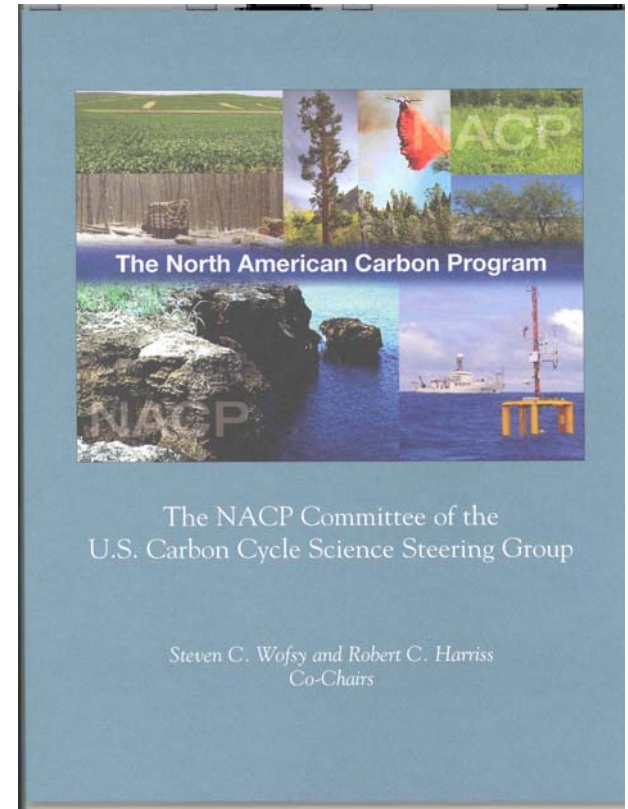
North American Carbon Program



North American Carbon Program (NACP)

The NACP has three overarching goals:

- **Develop quantitative scientific knowledge, robust observations, and models to determine the emissions and uptake of CO_2 , CH_4 , and CO , the changes in carbon stocks, and the factors regulating these processes for North America and adjacent ocean basins**
- **Develop the scientific basis to implement full carbon accounting on regional and continental scales**
- **Support long-term quantitative measurements of sources and sinks of atmospheric CO_2 and CH_4 , and develop forecasts for future trends**



A major step toward implementing the NACP was achieved with the publication of *The North American Carbon Program (NACP)* in 2002.



NACP in Context of U.S. CCSTI

Committee on Climate Change Science and Technology Integration

Interagency Working Group on Climate Change Science and Technology

Climate Change
Science Program

Climate Change
Technology Program

U.S. Global Change
Research Program
(USGCRP)

Climate Change
Research Initiative
(CCRI)

Carbon Cycle Science

3 Key Science Areas

NACP

NACP



aircraft



ships

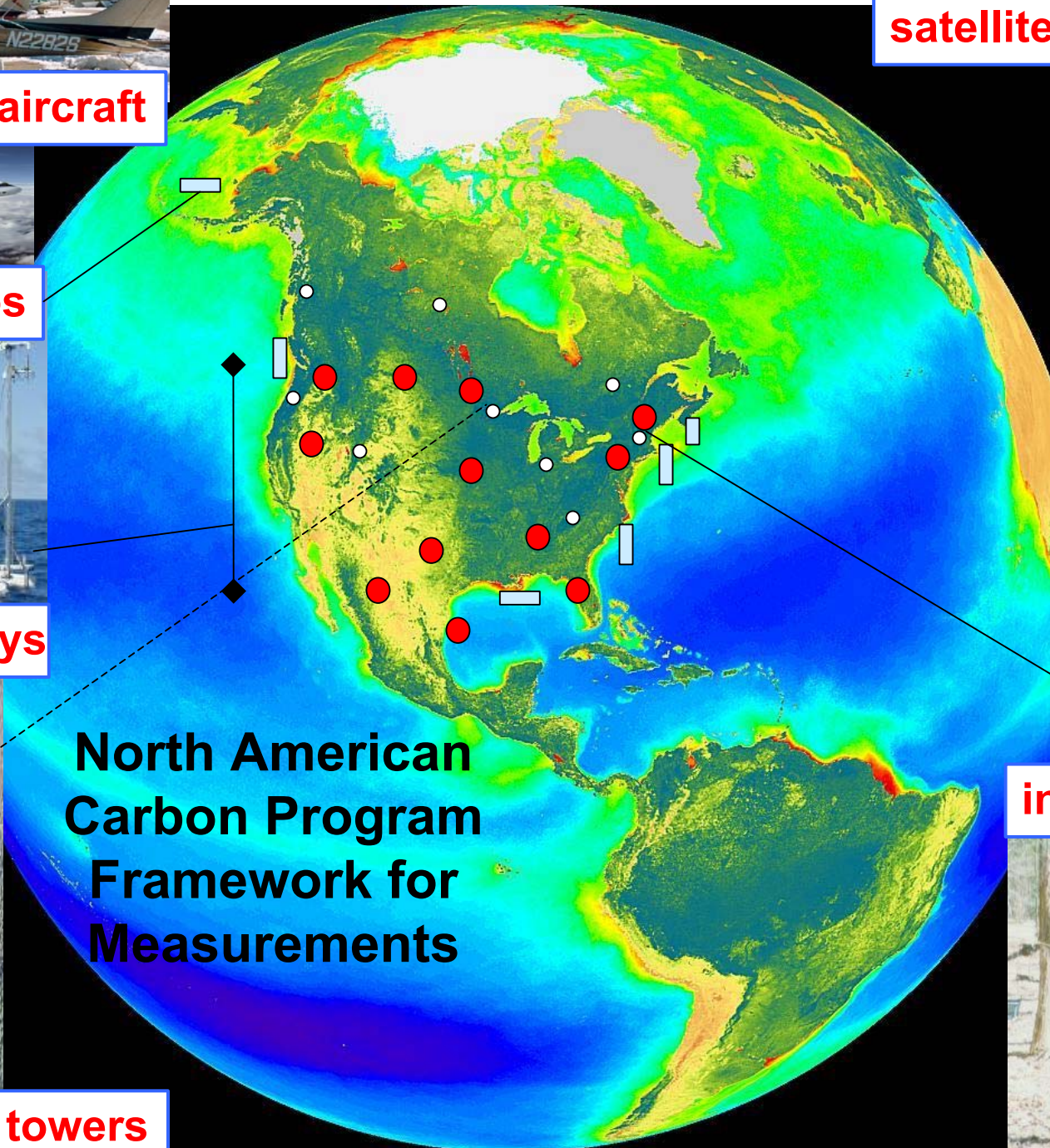


buoys

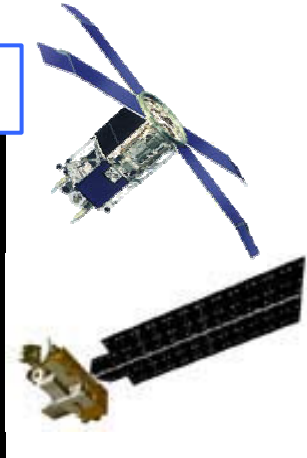


tall towers

**North American
Carbon Program
Framework for
Measurements**



satellites



flux towers

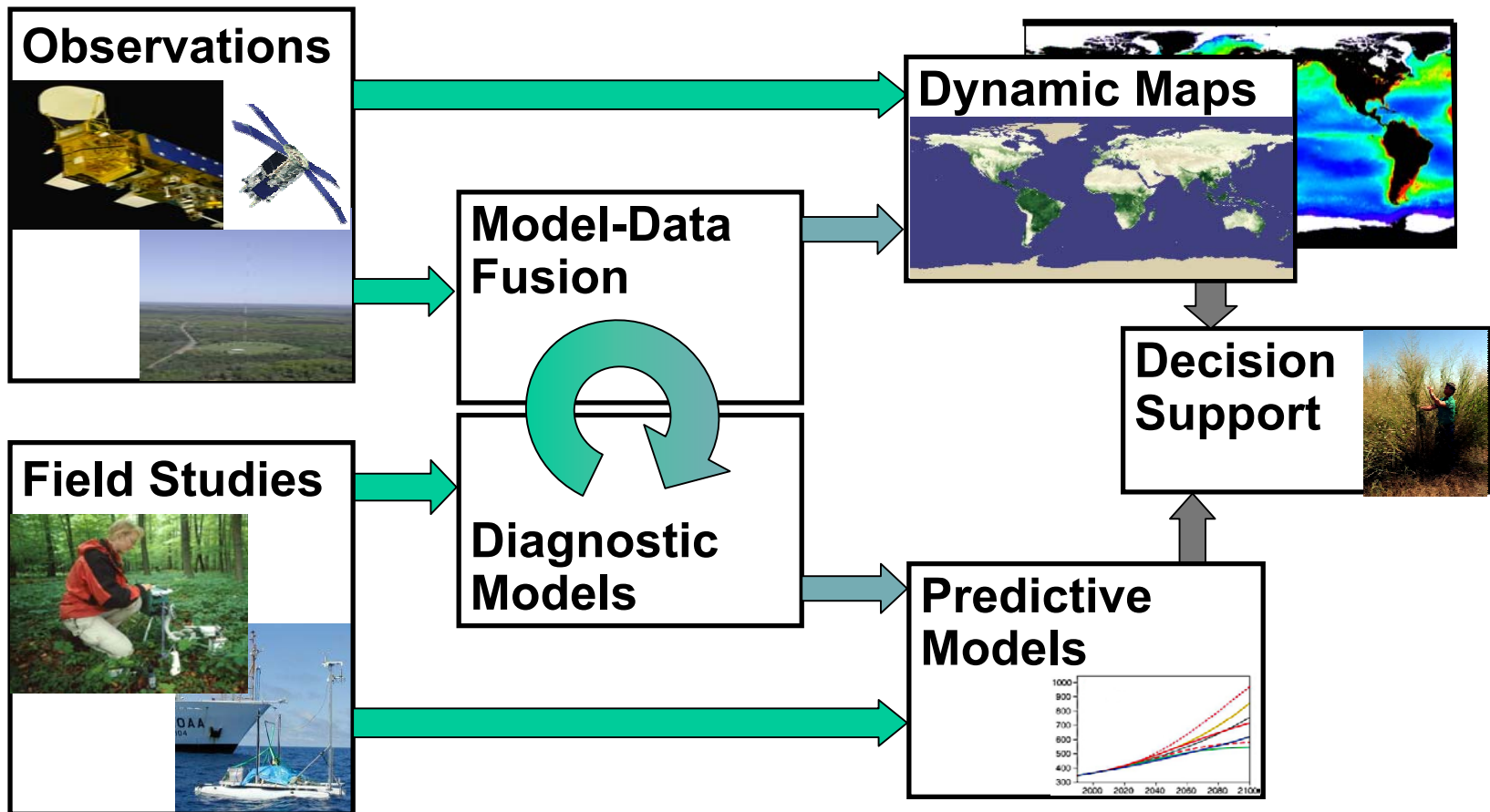
inventories





North American Carbon Program Integration

The NACP will quantify the magnitudes and distributions of carbon sources and sinks, explain the processes controlling them, and produce a consistent analysis of North America's carbon budget.



Observations & Experiments \Rightarrow Science Results \Rightarrow Estimates & Uncertainties



Potential Five Year Deliverables for NACP

- Consistent quantification (from independent methods) of carbon sources and sinks over North America, from regional to continental scales
- Quantification of the causes of terrestrial carbon sources and sinks, including land management, at multiple time scales
- Consistent quantification of the North American contribution to the Northern Hemisphere terrestrial carbon sink
- Specific design recommendations and prototypes for sampling networks, process research, data assimilation and prognostic modeling capabilities to improve future projections of the North American carbon balance
- *First State of the Carbon Cycle Report (SOCCR) for North America*



NACP Mid-Continent Intensive

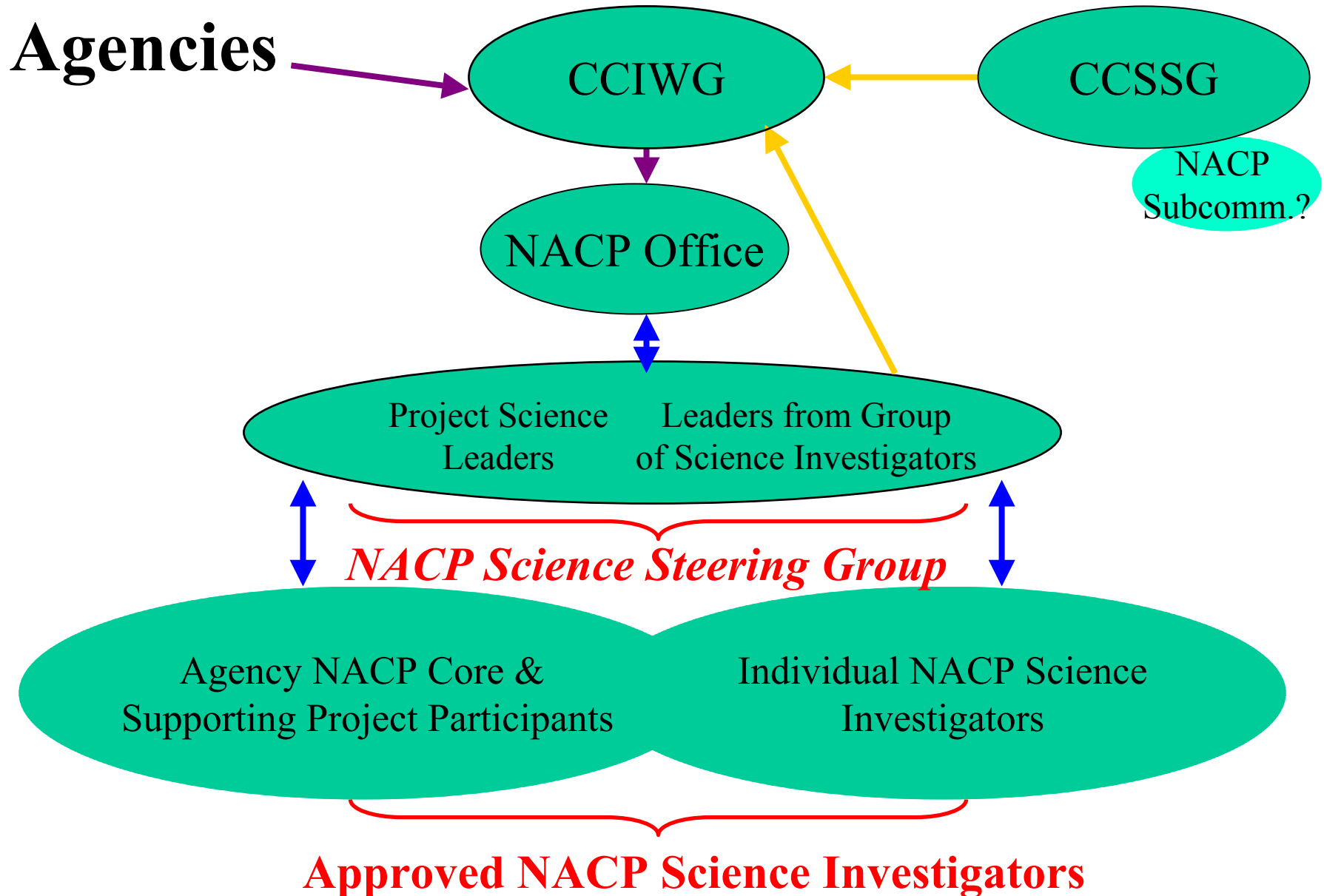
- **The Mid-Continent intensive campaign is the first of what could be a series of intensive studies to develop and evaluate key approaches for NACP.**
- **It will reconcile estimates of regional carbon sources and sinks derived from atmospheric models using measurements of trace gas concentrations with direct estimates based on field measurements, inventories, regional geographic information, and remote sensing data.**
- **It will attribute sources and sinks to ecosystem processes and human activities within the region.**
- **It will emphasize a multi-state area of the upper Midwestern U.S. Certain types of studies will need to focus smaller or more expanded areas.**



NACP Program Management Plan

- **NACP Program Office to be established soon at Climate Change Science Program Office (CCSPO)**
 - **Full-time Director**
 - **Staff with full-/part-time detailees, etc.**
- **Management, coordination, and oversight by CCIWG**
- **Scientific leadership and direction from an NACP Science Steering Group (SSG), with scientific oversight by CCSSG -- NACP SSG being established now; Dr. Scott Denning to Chair NACP SSG**

NACP Organizational Structure (in U.S.)





NACP: Noteworthy Events

- Workshops

- Remote Sensing for NACP (Aug., MT)
- *In situ* science for Mid-Continent Intensive (Sept., IA)
- AmeriFlux add-on for Mid-Continent Intensive (Oct., CO)
- *LU/LC - Carbon Program Coordination Workshop (tbd)*
- **Data Management for NACP (January, 2005 in LA)**
- Ocean Carbon (to include NACP ocean work; tbd in 2005)

- Workshops to be developed

- to further develop/prioritize other *Intensives* for NACP
- NACP science development for integrated North American analysis with Canada (& Mexico?)



Partnerships for NACP

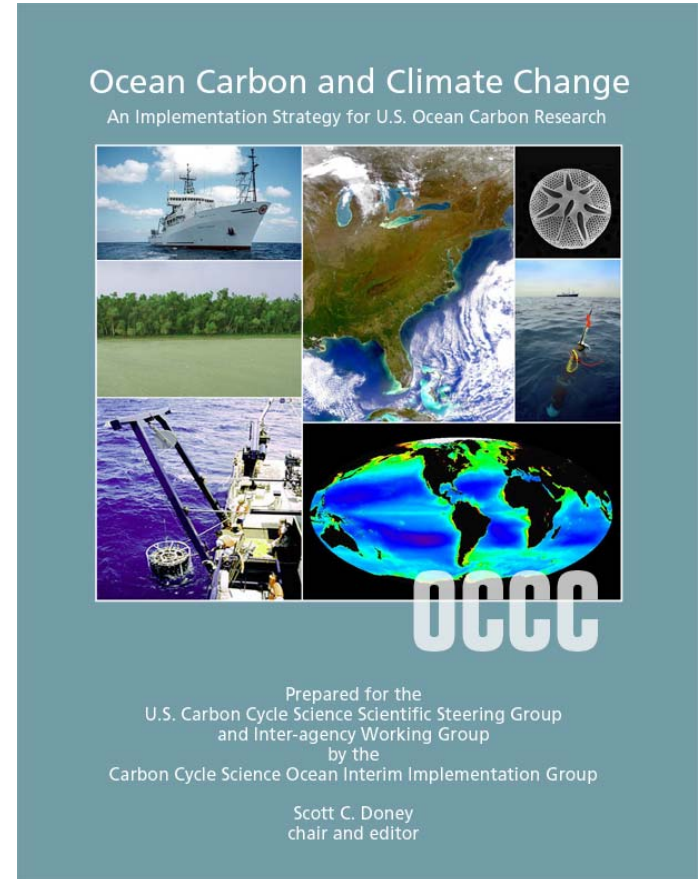
- With Neighbors to the North and South
 - Canadian scientists involved in science planning
 - Discussions with Canadian Government ongoing (ad hoc working group)
 - U.S.-Canada bilateral includes detailed statement of intent to work together on NACP (drafted in advance by ad hoc U.S.-Canada NACP working group)
 - U.S.-Mexico bilateral identified NACP as an activity of interest; small program-oriented workshop held in October, 2004
- With Europe
 - U.S.-EU bilateral discussions to cross compare results, work on Northern Hemisphere carbon budget, and develop measurement protocols and standards



Ocean Carbon and Climate Change

Role of the ocean in regulating atmospheric CO₂ levels:

- 1) Ocean natural and anthropogenic CO₂ inventory
- 2) Magnitude and variability of air-sea CO₂ flux
- 3) Feedback mechanisms and climate sensitivities for ocean carbon storage
- 4) Scientific basis for mitigation strategies



A major step toward implementing the oceanic component of NACP was achieved with the publication of *Ocean Carbon and Climate Change* in 2004.



Ocean Carbon and Climate Change

For NACP:

Diagnostic Analysis

- remote sensing imagery
- atmospheric observing system
- hydrologic transfers (land to coastal ocean)
- open and coastal ocean measurements
- modeling (process; data assimilation)
- intensive field campaigns

Process-Oriented Research Predictive modeling Decision support resources

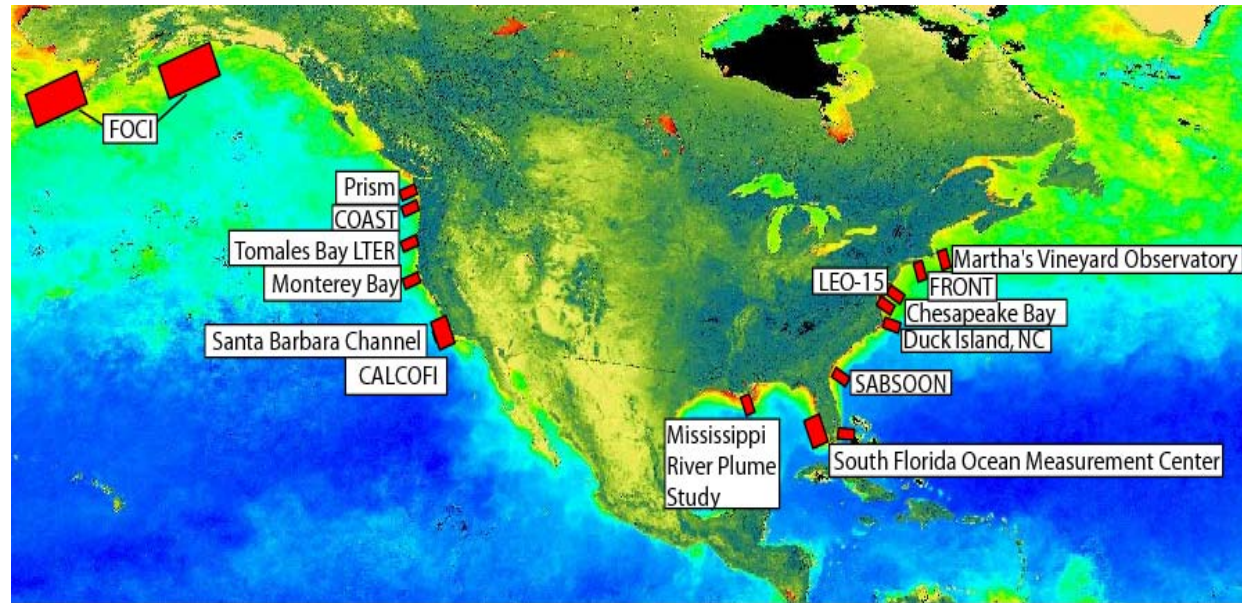
Continental Margin

Backbone ~12 moored TS

Ship transects

**Remote sensing synthesis
and *in situ* calibration**

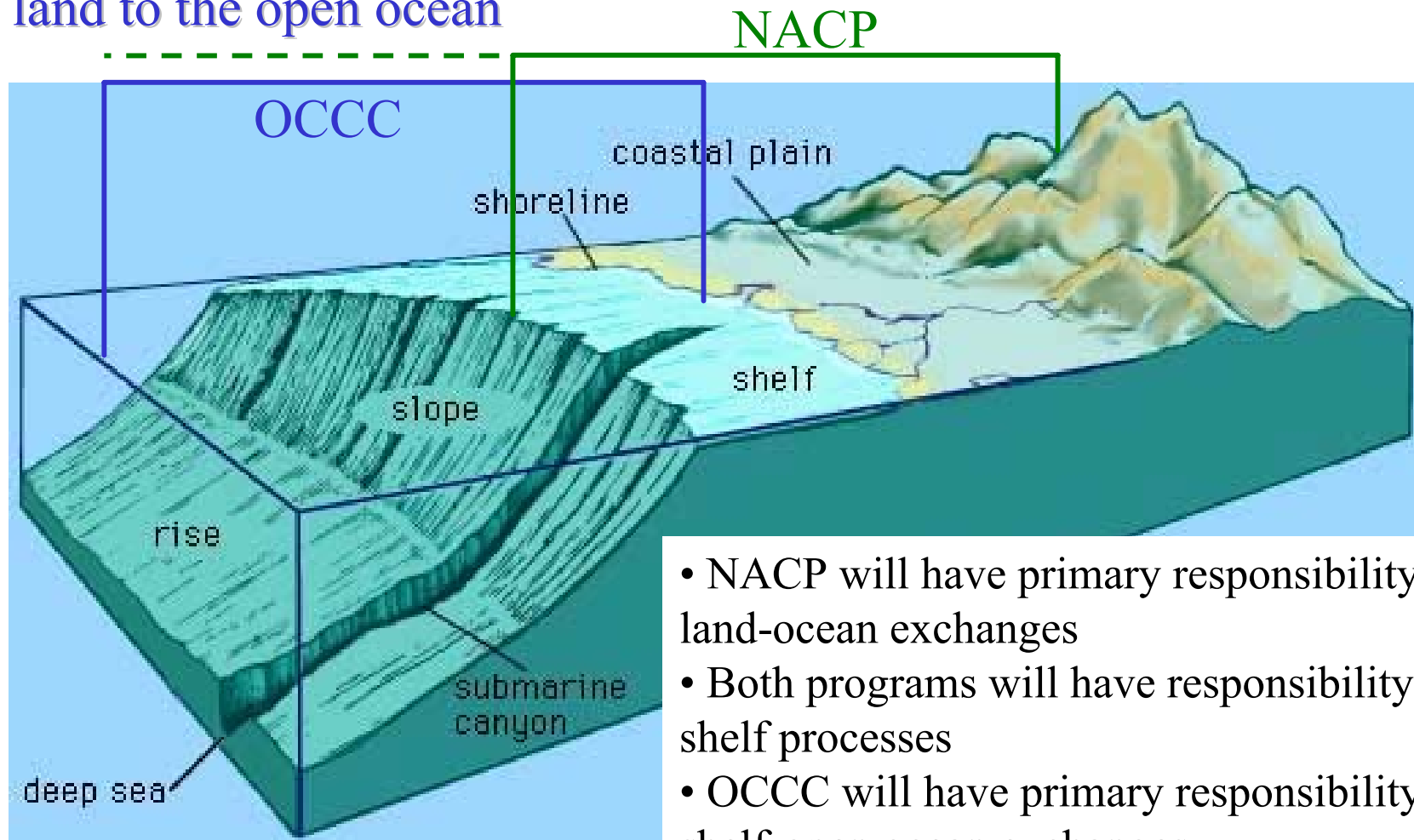
**Process studies in context
of existing/new time-series**





Relationship between OCCC and NACP

NACP and OCCC will be coordinated to cover a continuum from dry land to the open ocean



- NACP will have primary responsibility for land-ocean exchanges
- Both programs will have responsibility for shelf processes
- OCCC will have primary responsibility for shelf-open ocean exchanges

Data Management in NACP



Data Management Needs for NACP

- Find and access relevant data and information
- Integrate data from a variety of sources that may be reported in differing ways and/or cover differing spatial and temporal domains
- Share data across a broad group of researchers who may use the data in different ways (e.g., to extrapolate or interpolate measurements; in models; to document processes or infer causality)
- Assess/document data quality and adherence to standards
- Support intensive field campaigns
- Make efficient use of existing data management capabilities, organizations, infrastructure, and resources
- Provide for long-term archival of key data and results